DOCUMENT RESUME

ED 048 994 RE 003 369

AUTHOR	Mustico, Thomas W.
TITLE	Some Implications From Paired Associate Learning On the Development of Reading Readiness.
PUB DATE	Dec 70
NOTE	13p.; Paper presented at the National Reading Conference, St. Petersburg, Fla., Dec. 3-5, 1970
AVAILABLE FROM	Twentieth Yearbook of the National Reading Conference, Inc., Marquette University, 1217 W. Wisconsin Ave., Milwaukee, Wis. 53233
EDRS PRICE	EDRS Price MF-$0.65 HC Not Available from EDRS.
DESCRIPTORS	*Associative Learning, Beginning Reading, College Students, Elementary School Students, High School Students, Learning Theories, *Paired Associate Learning, Perception, Phonics, Reading Instruction, *Reading Processes, *Reading Readiness, Reading Research, Socioeconomic Background

ABSTRACT

Relationships existing between elements of intelligence, age, and environment and meaningfulness of materials were examined along with the hypothesis that an increase in meaningfulness of materials would cause the mean difference in learning scores for different intelligence levels to first increase, then decrease. In a paired-associate task, three lists of eight CVC trigram pairs of varying meaningfulness ratings were presented 10 times each to 292 subjects. Of these, 55 were college sophomores, 60 were high school seniors, 60 were high school freshmen, 57 were sixth graders, and 60 were third graders. Data collected on each subject included an IQ score, a socioeconomic status rating, and four measures of association on the trigram pairs representing varying degrees of meaningfulness. Results showed that relationships did in fact exist between intelligence and meaningfulness, between age and meaningfulness, and between socioeconomic status and meaningfulness. Mean differences in learning and IQ decreased with increases in meaningfulness, but in differing degrees for different age levels. Implications of these results for beginning reading instruction are discussed and include increased attention to associating tasks with children's experiences, language patterns, and environment. References and tables are included. (MS)

ED048994

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

"PERMISSION TO REPRODUCE THIS COPYRIGHTED MATERIAL BY MICROFICHE ONLY HAS BEEN GRANTED BY
National Reading Conference
TO ERIC AND ORGANIZATIONS OPERATING UNDER AGREEMENTS WITH THE U.S. OFFICE OF EDUCATION. FURTHER REPRODUCTION OUTSIDE THE ERIC SYSTEM REQUIRES PERMISSION OF THE COPYRIGHT OWNER."

Some Implications From Paired Associate Learning On the Development of Reading Readiness

Thomas W. Mustico
SUNY College at Oswego

Although the original purpose of the following study was to investigate some of the relationships which might exist among learning, intelligence, and pre-requisite achievement, both the conclusions of the study itself and those of the literature reviewed in the process, have generalizations which extend into the area of reading readiness. Dechant (1, p.171) has pointed out that, "Learning almost universally involves an association of the unknown with the known." He further states (1, p.172), "Meaning can be associated with the printed word only by associating the word with an experience. . ."

The quantity and quality of experiences which are relevant if not absolutely pre-requisite to learning to read must be what is commonly referred to as reading readiness. In other words reading, as any other learning task, requires a background

RE003 369

of pre-requisite learnings before the accomplishment of the desired learning task can be achieved. The purpose of the following study was to investigate the relationship between learning in the Paired-Associate (PA) task and measured intelligence, as opposed to the relationship between PA learning and associative meaningfulness. Additional variables of age and SES were also considered. The theoritical position from which the hypotheses of this study were generated is that the basic determiner of rate of learning for a given task is the amount of task relevant achievement brought to the learning situation.

This position suggests that prediction of learning rate (achievement in a fixed time learning situation) by means of intelligence tests occurs because IQ scores reflect a general level of achievement. In reflecting achievement in general, these scores tend to reflect achievements which are specific or prerequisite to a given learning task. In light of this, the study was directed toward an examination of an operationally defined specific achievement (production meaningfulness) which is considered to be indicitive of the response learning phase of the PA task and thus prerequisite to the associative learning phase of the task. If indeed the variable of meaningfulness is prerequisite or readiness for the PA task it would be a better predictor of success in PA learning than would IQ.

Hypotheses

If IQ scores and meaningfulness represent measures of general and specific achievements respectively, then there should be a tendency for an increase in general achievement to be accompanied by an increase in the specific achievement. This expectation was expressed as Hypothesis I: There is a positive relationship between the measured intelligence of subjects and the total meaningfulness of verbal materials to subjects.

If meaningfulness is defined as a construct which is measured by the number of associations available to a stimulus, then the source of meaningfulness must lie in

the development of associations. Following S-R theories associations are formed by contiguity in time and strengthened by repeated exposure. Underlying meaningfulness, then, must be some function of frequency in the environment. Aspects of frequency have been investigated by Noble (8), Gannon and Noble (4), Underwood and Schulz (11), Johnson (6) and DiMascio (2) with the notion that components of high meaningful materials occur with greater frequency in the environment in general than do the components of low meaningful meaterials. But by selecting groups which have had varing restrictions in environmental exposure (opportunity for prior learning) because of age or SES, it becomes possible to examine the position that meaningfulness can be interpreted as prior learning. Hypotheses II and III were framed as follows: There is a positive relationship between age of subjects and the total meaningfulness of verbal materials to subjects; and there is a relationship between the rating of the environment of subjects and the total meaningfulness of verbal materials to subjects.

The hypothesized relationship between IQ scores and meaningfulness scores expressed in Hypothesis I predicted a tendency for higher IQ subjects to indicate through associations that the materials used in this study are more meaningful to them than they are to low IQ subjects. If the learning rates of the IQ groups were the same and the relationship between meaningfulness and learning was linear, parallel slopes would be expected when the learning of the two groups was compared across levels of increasing meaningfulness. The relationship between meaningfulness and intelligence was expected to be sigmoidal rather than linear. If two identical sigmoid curves are separated by displacing one on the abscissa, the relationship between the two becomes one where the two curves are closest at extreme positions on the abscissa. This leads to the expectation that mean differences in learning scores of the high and low IQ groups would be greatest at mid-range of meaningfulness and least at extremes. These notions were expressed as Hypothesis IV: As the average meaningfulness

values of learning materials increases, the mean difference in learning scores for different intelligence levels will first increase then decrease.

Methods and Procedures

The verbal materials used in the learning task were three letter combinations (trigrams) in the forms of consonant, vowel, consonant (CVC) and three consonants (CCC). Initially a set of 80 trigrams were selected from previous lists developed by Witmer (11) and Noble (9) so as to cover a wide range of meaningfulness. These initial trigrams were presented to subjects at each of five educational levels (approximately 80 at each level), in order to determine actual mean number of associations (meaningfulness values) to each of the trigrams for the subjects involved in the study. On the basis of the means and standard deviations of the number of associations of subjects, six trigrams were selected at each of four meaningfulness levels. These trigrams were then randomly paired with a two-digit stimulus number and randomly assigned to one of three learning lists with the condition that two trigrams from each level appear on each list. These lists were presented to subjects in partially counterbalanced orders as paired-associate learning tasks. Each list was presented ten times, one pair at a time (two second exposure, one second interspace), and measurements of learning were taken between each complete presentation of a list (eight pairs). In order for a subject to be credited with learning, he had to write the appropriate trigram when presented with the stimulus number. Maximum learning score was 240 (3 lists x 8 members x 10 presentations).

The sample

The original population from which the sample was drawn consisted of college sophomores enrolled in an introductory course in Educational Psychology at the State University of New York at Albany and all members of grades 3, 6, 9, and 12 in

attendance at the schools of Central School District No. 1, Towns of Sand Lake and Poestenkill (Rennselaer County, New York). Selections of classrooms at the non-college level were made randomly unless subjects were grouped homogeneously on an intelligence variable.

Subjects for the final sample were selected on the basis of whether or not data was available from the association task, the learning task, intelligence testing, and school records (age and father's occupation used in the determination of SES). High and low intelligence groups were selected as the upper and lower 20 scores at each of the five grade levels. The final sample was composed of 292 subjects on whom complete data was available. Of the 292 subjects, there were 55 college sophomores, 60 12th-graders, 60 9th-graders, 57 6th graders, and 60 3rd-graders. The first three hypotheses were tested using data from 292 final subjects; Hypothesis IV was tested using data based on 200 subjects (the highest and lowest 20 scores on the IQ variable at each of five grade levels).

The data

The following data were collected from each subject:

1. score on IQ test (Otis Alpha, Beta, Gamma, or CTMM)
2. rating of socio-economic status (SES)
3. number of associations to each of 80 trigrams (m)
4. total number of associations to trigrams (M)
5. total m for trigrams used at four learning levels (m_1, m_2, m_3, m_4,)
6. learning scores for materials at four learning levels.

Results

Hypothesis I was supported. A significant Partial = (IQ x M.CA, .38, $p < .001$) was found between intelligence tests scores and the total number of associations produced by subjects to the 80 initial trigrams submitted to them.

Hypothesis II was supported. A significant Pearson r (.70, $p < .001$) was found between age of subjects and the total number of associations they produced to the initial 80 trigrams.

Hypothesis III was supported. A significant Spearman's Rho (-.17, $p < .01$) was found between ratings of socio-economic status of subjects and the total number of associations they produced to the 80 trigrams. The negative sign of the coefficient is due to the assignment of low ranks to upper SES categories by the Edward's (3) scale.

Hypothesis IV was supported in part. The predicted decrease in the relationship between IQ and learning was found between meaningfulness level 3 (.43, N=292) and level 4 (.25, N=292). This decrease was tested using Totaling's *t* for correlated correlations and found to be a significant difference ($p < .001$). Table 1 is a presentation of the differences in meaning learning scores (number of correct responses) for high and low intelligence subjects at five grade levels for four levels of meaningfulness. The tendency for mean differences in learning scores to decrease as meaningfulness increases from level 3 to 4 can be seen at all grade levels. A tendency for a decrease in mean learning scores as meaningfulness decreases from level 2 to level 1 is not substantially evident at any grade. The supposition that mean differences in learning scores at the mid-range of meaningfulness values would be significantly different from no difference at the .05 level was supported in eight of the ten cases.

Confirmation of Hypothesis II indicates that the trigrams used in the learning task tended to be more meaningful for the older subjects. Thus the most meaningful learning materials tended to be the CVC trigrams learned by the college sophomores and the lowest meaningful materials tended to be the CCC trigrams learned by the third graders.

Differences in mean learning scores of high and low IQ groups fail to be significantly different ($p < .05$) for sophomores learning the CVC materials and 3rd graders learning the CCC materials. This difference was examined after finding a significant triple interaction (M x IQ x Grade).

TABLE 1

Mean Differences in Learning Scores at Four Levels of Meaningfulness for High Versus Low IQ Groups

Grade	Meaningfulness level			
	1	2	3	4
14	5.35*	5.95*	3.75	2.75
12	15.20*	13.50*	7.00*	5.65*
9	15.70*	18.90*	12.15*	3.45
6	11.30*	11.95*	14.50*	6.75*
3	.40	.55	5.45*	3.15

* $p < .05$ (One tail)

The relationship between the meaningfulness of materials used in the PA task and the learning scores produced can easily be overlooked by the use of either single part scores or the total score. This occurs because the correlations between meaningfulness scores and the learning scores at each of the four levels of the PA task when taken by grade level fail to be sensitive to the differences in learning which occur between meaningfulness levels (the within subject variation due to differences in learning materials). Total scores (LT) for all four subsections of the PA task and total meaningfulness of material learned (m_t) when correlated with IQ also fail to demonstrate that the IQ is insensitive to the within subject variation across learning levels. When scores of this latter nature are used, only the total sample

discription yields a high r between learning scores and the associative fluency of subjects. These relationships between m_t, IQ, and LT at each grade level are presented in Table 2. This table is based on the data from the High - Low IQ sample of 200 subjects, 40 at each of the five grade levels.

TABLE 2

Correlations Among IQ, Associative Fluency, and Total PA Learning at Each of Five Grade Levels

Grade	df	r		
		IQ x m_t	IQ x LT	LT x m_t
14	38	.159	.467	.220
12	38	.280	.614	.295
9	38	.287	.789	.217
6	38	.476	.601	.289
3	38	.424	.155	.443
Total	198	.397	.478	.660

On the other hand when the number of associations (m_1, m_2, m_3, m_4) elicited to each of the four groups of six trigrams for each of the 40 subjects at five grade levels well pooled and correlated, strong correlations between associations and learning occur consistently both within and across grade levels. The insensitivity of IQ to the within learning differences now results in a marked lowering of the relationship between IQ and learning (LS) at each of the grade levels. The df associated with the correlations presented in Table 3 have increased because they are based on four association and four learning scores for each subject.

TABLE 3

Correlations Among IQ, Association Scores, and Learning Scores Combined Across Learning Materials at Each of Five Grade Levels

Grade	df	r		
		IQ x ASN	IQ x LS	LS x ASN
14	158	.078	.251	.610
12	158	.107	.376	.652
9	158	.135	.468	.666
6	158	.286	.324	.616
3	158	.243	.068	.683
Total	798	.349	.264	.710

The graphical information presented in Figure 1 seems to indicate that the average number of associations produced to the trigrams (response members of PA tasks) prior to the learning tasks accounts for more of the variance in mean learning scores than does measured IQ. It can be seen in this figure that a mean of approximately 2.5 associations was produced by High IQ G_{14} (level 1), Low IQ G_6 (level 3), Low IQ G_{14} (level 1) and Low IQ G_3 (level 4). The mean learning score of the 2 former groups was approximately 30 and that of the 2 latter groups was approximately 25.

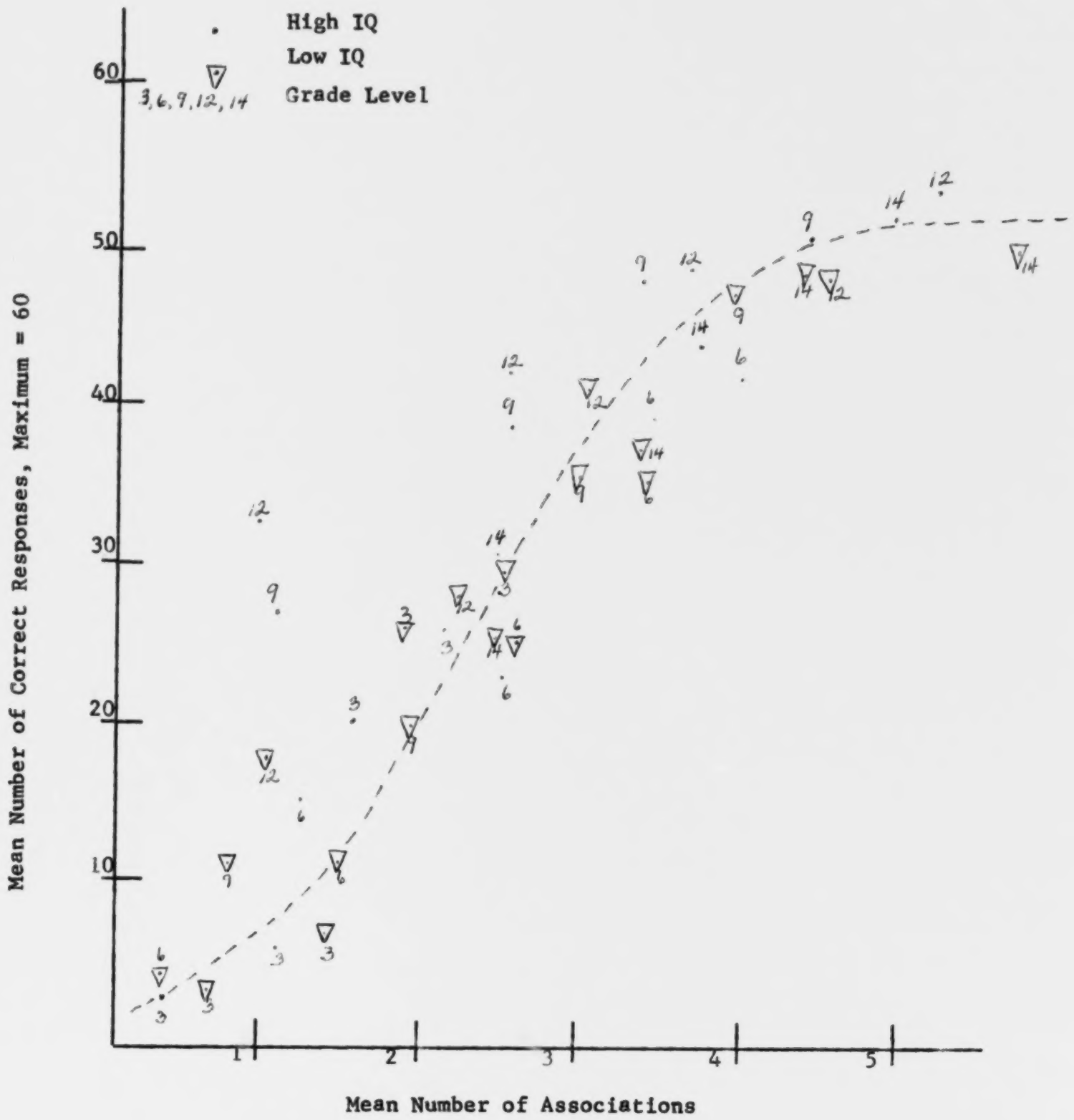

Fig. 1. Mean learning scores of high and low IQ groups from each of five grade levels, for six trigrams at each of four meaningfulness levels, as a function of the number of associations elicited from members of each group

Implications for reading readiness

Inasmuch as reading is in its initial stages an associative process the attention that is paid to the formation of associations in the development of reading readiness is well justified. Emphasis should be placed on broadening the associations of the child, so that the sight and sound of letters and words become more meaningful. Although simple elicitation of associations has typically not been considered to constitute meaning in the sense of a concept, research by Jenkins and Russell (5) has shown a high degree of correlation to exist between the number of associations produced to a stimulus and the displacement of that stimulus from the neutral point in the semantic differential.

Meaningfulness is related to various measures of environmental occurrence. Lack of environmental experience with letters, numbers, and words must be compensated for in the process of developing reading readiness. Research by DiMascio (2) has shown that even with readers the ability to recall a syllable is related to the frequency of occurrence of the letters of the syllable in the written language.

(1) Associations to the individual letters as the initial letters of words and objects in the environmental experience of pre-readers probably cannot be over emphasized in the process of developing associative meaningfulness for the letters themselves.

(2) Utilization of words which are emotional charged should occur, to take advantage of the broader associate network or meaningfulness that are characteristic of these words.

(3) Even the direct teaching of random associations to nonsense syllables enhances the learning of this nonsense, and perhaps for many pre-readers letters and words are nonsense.

(4) Paired associate research indicates that pronounceability of nonsense is associated with learning in the PA task. Associations to phonic elements in words which are taught for the purpose of sounding out a word should be formed to a wide variety of words which occur in the environmental experience of the pre-reader.

(5) The initial reading vocabulary should be closely associated with the common speaking vocabulary of the child in that initial reading is a strenghtening of associations between the written word and the spoken word.

(6) Although scores on IQ tests are related to associative fluency in general, that associations play a greater role in PA learning than does IQ. Initial reading at least is very much like the paired associate task.

References

1. Dechant, Emerald B., Improving the Teaching of Reading. Englewood Cliffs, N. J.: Prentice Hall, Inc., 1964.

2. DiMascio, A., "Learning Characteristics of Nonsense Syllables; A Function of Letter Frequency," Psychological Reports, 5 (1959) 585-591.

3. Edwards, Alba M., Alphabetical Index of Occupations by Industries and Socio-economic Groups. Washington, (U.S. Dept. of Commerce): U.S. Printing Office, 1937.

4. Gannon, D. and Noble, C., "Familiarization (n) as a Stimulus Factor in Paired-Associate Verbal Learning," Journal of Experimental Psychology, 62 (1961) 14-23.

5. Jenkins, J.J., and Russell, W.A., Annual Technical Report: Basic Studies on Individual and Group Behavior. Contract No. N8 onr-66216 between Office of Naval Research and University of Minnesota, 1956.

6. Johnson, R., "Reanalysis of Meaningfulness and Verbal Learning," Psychological Review, 69 (1962) 233-238.

7. Mustico, T., Meaningfulness, Intelligence, and Rate of Learning. (Unpublished doctoral dissertation) Albany: State University of New York, 1968.

8. Noble, C., "The Meaning Familiarity Relationship," Psychological Review, 60 (1953) 89-98.

9. _____, "Measurements of Association Value (a), Rated Associations (a), and Sealed Meaningfulness (m), for the 2100 CVC Combinations of the English Alphabet," Psychological Reports, 8 (1961) 487-521.

10. Underwood, B. and Schulz, R., Meaningfulness and Verbal Learning. Chicago: Lippincott, 1960.

11. Witmer, L., "The Association Value of Three Phase Consonant Syllables," Journal of Genetic Psychology, 47 (1955) 337-360.